Potassium (K^+) in plants

Potassium (K^+) is the most abundant inorganic cation in plant cells. Many research publications on K^+ start in a similar way, including my own. Indeed, K^+ is vital for plant growth. Together with nitrogen (N) and phosphorous (P), K^+ belongs to the top three elements, the availability of which strongly determines crop yield. Undeniably, the application of mineral NPK-fertilizers was an essential cornerstone of the green revolution in the last century.

Limited resources are now forcing us to investigate how the plants' K^+ demand can be satisfied with the minimum of fertilizer application. The indispensable ground for providing answers to this complex question is the understanding of the exact roles of K^+ in plants. This special issue provides contemporary views from different perspectives on 'Potassium in Plants'. It spans the whole range, from agricultural aspects of potassium nutrition (Zörb et al., 2014), through the manifold physiological roles that K^+ plays (Anschütz et al., 2014; Demidchik, 2014), to the molecular aspects of potassium uptake from the soil (Nieves-Cordones et al., 2014) and its distribution throughout the plant (Ahmad and Maathuis, 2014; Wigoda et al., 2014). It addresses the molecular bases of the subcellular compartmentalization of K^+ (Hamamoto and Uozumi, 2014), as well as the problematic relationship of K^+ with its 'evil' twin, the sodium ion (Na^+), which together with Cl^-, is the main damaging effect of yield-reducing salt stress (Benito et al., 2014; Pottosin and Dobrovinskaya, 2014).

The molecular knowledge of K^+ transport in plants has mainly been obtained from only a few model species. Only recently have the number of investigated species started to increase significantly. Véry et al., 2014 summarize exemplarily the available information for three K^+ transporter classes and discuss the question as to how much this available information from model species can be transferred to other plant species.

The involvement of K^+ (and, of course, other nutrients) in the diverse range of physiological processes is highly dynamic and is so complex that an intuitive understanding is often difficult or even misleading. However, modern approaches can offer a way out of this dilemma. To get a 'feeling' for the system's behavior, we need to feed computer programs with all the information gathered in 'wet-lab' experiments and run computational simulations (so called 'dry-lab' experiments). The computer allows quick changes of parameters, thus enabling the possibility of testing many hypotheses in a short time to filter those out that are worth testing in (time-consuming and much more expensive) wet-lab experiments. To ease the path into this 'next generation experimentation', Blatt et al., 2014 provide a hands-on tutorial to simulate exemplarily behavior of guard cells.

This compendium prepared by 34 authors, provides a stock-check of the current knowledge in the field. In addition, it will provide readers who are not familiar with the subject, a first step toward a holistic view on 'Potassium (K^+) in Plants'.

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